CLAIMS

What is claimed is:

1. A method of obtaining predictive information for inhomogeneous financial time series, comprising the steps of:

electronically receiving financial market transaction data over an electronic network;

electronically storing in a computer-readable medium said received financial market transaction data;

constructing an inhomogeneous time series z that represents said received financial market transaction data;

constructing an exponential moving average operator;

constructing an iterated exponential moving average operator based on said exponential moving average operator;

constructing a time-translation-invariant, causal operator $\Omega[z]$ that is a convolution operator with kernel ω and that is based on said iterated exponential moving average operator;

electronically calculating values of one or more predictive factors relating to said time series z, wherein said one or more predictive factors are defined in terms of said operator $\Omega[z]$; and

electronically storing in a computer readable medium said calculated values of one or more predictive factors.

2. The method of claim 1, wherein said operator $\Omega[z]$ has the form:

$$\begin{aligned}\Omega[z](t) &= \int_{-\infty}^{t} dt'\omega(t-t')\, z(t') \\ &= \int_{0}^{\infty} dt'\omega(t')\, z(t-t').\end{aligned}$$

3. The method of claim 1, wherein said exponential moving average operator $\mathrm{EMA}[\tau\,;z]$ has the form:

$$\begin{aligned}\mathrm{EMA}[\tau;z](t_n) &= \mu\ \mathrm{EMA}(\tau;z](t_{n-1}) + (\nu-\mu)\, z_{n-1} + (1-\nu)\, z_n, \text{ with} \\ \alpha &= \frac{\tau}{t_n - t_{n-1}}, \qquad (23) \\ \mu &= e^{-\alpha},\end{aligned}$$

where v depends on a chosen interpolation scheme.

4. The method of claim 1, wherein said operator $\Omega[z]$ is a differential operator $\Delta[\tau]$ that has the form:

$$\Delta[\tau] = \gamma(\mathrm{EMA}[\alpha\tau, 1] + \mathrm{EMA}[\alpha\tau, 2] - 2\ \mathrm{EMA}[\alpha\beta\tau, 4]),$$

where γ is fixed so that the integral of the kernel of the differential operator from the origin to the first zero is 1; α is fixed by a normalization condition that requires $\Delta[\tau; c] = 0$ for a constant c; and β is chosen in order to get a short tail for the kernel of the differential operator $\Delta[\tau]$.

5. The method of claim 4 wherein said one or more predictive factors comprises a return of the form $r[\tau] = \Delta[\tau; x]$, where x represents a logarithmic price.

6. The method of claim 1 wherein said one or more predictive factors comprises a momentum of the form $x - \mathrm{EMA}[\tau\,; x]$, where x represents a logarithmic price.

7. The method of claim 1 wherein said one or more predictive factors comprises a volatility.

8. The method of claim 7 wherein said volatility is of the form:

$$\text{Volatility}\,[\tau, \tau', p; z] = \mathrm{MNorm}\,[\tau/2, p; \Delta[\tau'; z]], \quad \text{where}$$

$$\mathrm{MNorm}[\tau, p; z] = \mathrm{MA}[\tau; |z|^p]^{1/p}, \quad \text{and}$$

$$\mathrm{MA}[\tau, n] = \frac{1}{n}\sum_{k=1}^{n} \mathrm{EMA}[\tau', k], \quad \text{with } \tau' = \frac{2\tau}{n+1}, \quad \text{and where } p \text{ satisfies } 0 < p \le 2,$$

and τ' is a time horizon of a return $r[\tau] = \Delta[\tau; \mathrm{x}]$, where x represents a logarithmic price.

9. A method of obtaining predictive information for inhomogeneous financial time series, comprising the steps of:

electronically receiving financial market transaction data over an electronic network;

electronically storing in a computer readable medium said received financial market transaction data;

constructing an inhomogeneous time series z that corresponds to said received financial market transaction data;

constructing an exponential moving average operator;

constructing an iterated exponential moving average operator based on said exponential moving average operator;

constructing a time-translation-invariant, causal operator $\Omega[z]$ that is a convolution operator with kernel ω and that is based on said iterated exponential moving average operator;

constructing a standardized time series $\hat{z}$;

electronically calculating values of one or more predictive factors relating to said time series z, wherein said one or more predictive factors are defined in terms of said standardized time series $\hat{z}$; and

electronically storing in a computer readable medium said calculated values of one or more predictive factors.

10. The method of claim 9 wherein the standardized time series $\hat{z}$ is of the form:

$$\hat{z}[\tau] = \frac{z - \mathrm{MA}[\tau;z]}{\mathrm{MSD}[\tau;z]} \text{, where}$$

$$\mathrm{MA}[\tau,n] = \frac{1}{n}\sum_{k=1}^{n} \mathrm{EMA}[\tau',k], \qquad \text{with } \tau' = \frac{2\tau}{n+1}, \qquad \text{and}$$

where $\mathrm{MSD}[\tau,p;z] = \mathrm{MA}\left[\tau;|z-\mathrm{MA}[\tau;z]|^{p}\right]^{1/p}$.

11. The method of claim 9 wherein said one or more predictive factors comprises a moving skewness.

12. The method of claim 11 wherein said moving skewness is of the form:

$\text{MSkewness}[\tau_1, \tau_2 ; z] = \text{MA}[\tau_1; \hat{z}[\tau_2]^3]$ where τ_1 is the length of a time interval around time "now" and τ_2 is the length of a time interval around time "now – τ".

13. The method of claim 12 wherein the standardized time series $\hat{z}$ is of the form:

$$\hat{z}[\tau] = \frac{z - \text{MA}[\tau;z]}{\text{MSD}[\tau;z]}, \text{ where}$$

$$\text{MA}[\tau,n] = \frac{1}{n}\sum_{k=1}^{n} \text{EMA}[\tau',k], \quad \text{with } \tau' = \frac{2\tau}{n+1}, \quad \text{and}$$

where $\text{MSD}[\tau,p;z] = \text{MA}\left[\tau;|z - \text{MA}[\tau;z]|^p\right]^{1/p}$.

14. The method of claim 9 wherein said one or more predictive factors comprises a moving kurtosis.

15. The method of claim 14 wherein said moving kurtosis is of the form

$\text{MKurtosis}[\tau_1, \tau_2 ; z] = \text{MA}[\tau_1; \hat{z}[\tau_2]^4]$, where τ_1 is the length of a time interval around time "now" and τ_2 is the length of a time interval around time "now – τ."

16. The method of claim 15 wherein the standardized time series $\hat{z}$ is of the form:

$$\hat{z}[\tau] = \frac{z - \text{MA}[\tau;z]}{\text{MSD}[\tau;z]}, \text{ where}$$

$$\text{MA}[\tau,n] = \frac{1}{n}\sum_{k=1}^{n} \text{EMA}[\tau',k], \quad \text{with } \tau' = \frac{2\tau}{n+1}, \quad \text{and}$$

where $\text{MSD}[\tau,p;z] = \text{MA}\left[\tau;|z - \text{MA}[\tau;z]|^p\right]^{1/p}$.

17. A method of obtaining predictive information for inhomogeneous financial time series, comprising the steps of:

electronically receiving financial market transaction data over an electronic network;

electronically storing in a computer readable medium said received financial market transaction data;

constructing an inhomogeneous time series z that corresponds to said received financial market transaction data;

constructing an exponential moving average operator EMA[τ ; z];

constructing an iterated exponential moving average operator based on said exponential moving average operator EMA[τ ; z];

constructing a time-translation-invariant, causal operator $\Omega[z]$ that is a convolution operator with kernel ω and time range τ, and that is based on said iterated exponential moving average operator;

constructing a moving average operator MA that depends on said EMA operator;

constructing a moving standard deviation operator MSD that depends on said MA operator;

electronically calculating values of one or more predictive factors relating to said time series z, wherein said one or more predictive factors depend on one or more of said operators EMA, MA, and MSD; and

electronically storing in a computer readable medium said calculated values of one or more predictive factors.

18. The method of claim 17 wherein said one or more predictive factors comprises a moving correlation.

19. The method of claim 18 wherein said moving correlation is of the form:

$$\text{MCorrelation}[\hat{y}, \hat{z}](t) = \int_0^\infty \int_0^\infty dt' \; dt'' \; c(t', t'') \, \hat{y}(t - t') \; \hat{z}(t - t'') \; .$$

20. A method of obtaining predictive information for inhomogeneous financial time series, comprising the steps of:

electronically receiving financial market transaction data over an electronic network;

electronically storing in a computer readable medium said received financial market transaction data;

constructing an inhomogeneous time series z that corresponds to said received financial market transaction data;

constructing a complex iterated exponential moving average operator EMA[τ ; z], with kernel ema;

constructing a time-translation-invariant, causal operator $\Omega[z]$ that is a convolution operator with kernel ω and time range τ, and that is based on said complex iterated exponential moving average operator;

constructing a windowed Fourier transform WF that depends on said EMA operator;

electronically calculating values of one or more predictive factors relating to said time series z, wherein said one or more predictive factors depend on said windowed Fourier transform; and

electronically storing in a computer readable medium said calculated values of one or more predictive factors.

21. The method of claim 20 wherein said complex iterated exponential moving average operator EMA has a kernel ema of the form:

$$\mathrm{ema}[\zeta, n](t) = \frac{1}{(n-1)!}\left(\frac{t}{\tau}\right)^{n-1}\frac{e^{-\zeta t}}{\tau}, \text{ where } \zeta \in \mathbb{C}, \text{ with } \zeta = \frac{1}{\tau}(1 + ik) .$$

22. The method of claim 20 wherein EMA is computed using the iterative computational formula:

$$\mathrm{EMA}[\zeta;z](t_n) = \mu\ \mathrm{EMA}[\zeta;z](t_{n-1}) + z_{n-1}\frac{\nu - \mu}{1 + ik} + z_n\frac{1 - \nu}{1 + ik}, \text{ with}$$

$$\alpha = \zeta(t_n - t_{n-1})$$

$$\mu = e^{-\alpha}$$

where ν depends on a chosen interpolation scheme.

23. The method of claim 20 wherein said windowed Fourier transform has a kernel wf of the form:

$$\mathrm{wf}[\tau, k, n](t) = \frac{1}{n}\sum_{j=1}^{n}\mathrm{ema}[\zeta, j](t) .$$

24. The method of claim 23 wherein said ema is of the form:

$$\mathrm{ema}[\zeta, n](t) = \frac{1}{(n-1)!}\left(\frac{t}{\tau}\right)^{n-1}\frac{e^{-\zeta t}}{\tau}, \text{ where } \zeta \in \mathbb{C}, \text{with } \zeta = \frac{1}{\tau}(1 + ik).$$

25. A method of obtaining predictive information for inhomogeneous time series, comprising the steps of:

electronically receiving time series data over an electronic network;

electronically storing in a computer-readable medium said received time series data;

constructing an inhomogeneous time series z that represents said time series data;

constructing an exponential moving average operator;

constructing an iterated exponential moving average operator based on said exponential moving average operator;

constructing a time-translation-invariant, causal operator $\Omega[z]$ that is a convolution operator with kernel ω and that is based on said iterated exponential moving average operator;

electronically calculating values of one or more predictive factors relating to said time series z, wherein said one or more predictive factors are defined in terms of said operator $\Omega[z]$; and

electronically storing in a computer readable medium said calculated values of one or more predictive factors.